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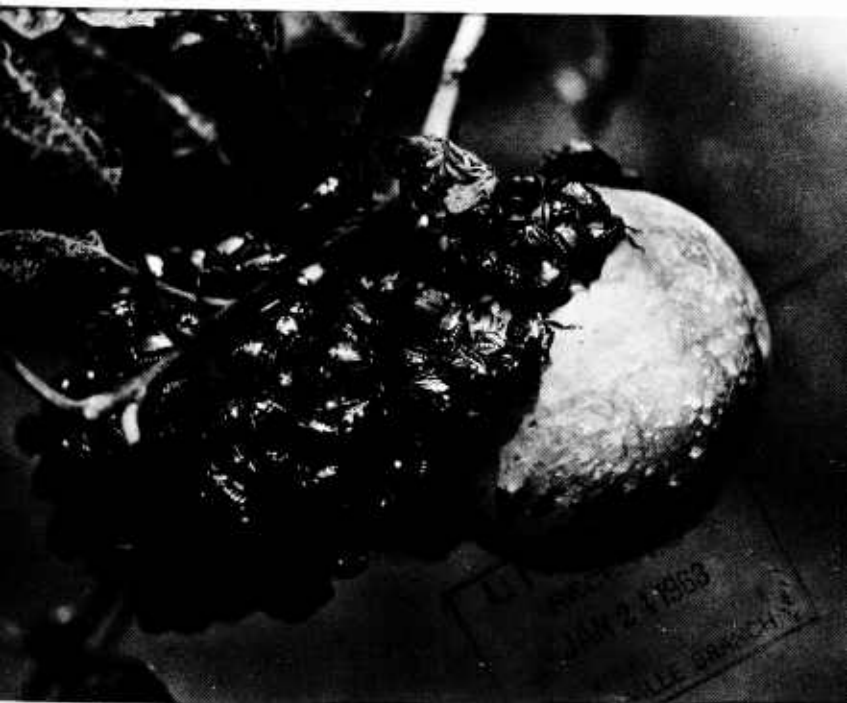
Supersedes Circular 332

See revised copy

The

# **JAPANESE BEETLE**

in the UNITED STATES



AGRICULTURE HANDBOOK NO. 236

Agricultural Research Service  
UNITED STATES DEPARTMENT OF AGRICULTURE

# CONTENTS

	Page
How to recognize the Japanese beetle.....	1
The adult.....	1
The egg.....	2
The grub.....	2
The pupa.....	3
Present distribution of the beetle in North America.....	5
Probable ultimate distribution of the beetle in North America.....	6
Temperature and moisture requirements of the beetle.....	6
Western spread of the beetle.....	7
Southern spread of the beetle.....	8
Northern spread of the beetle.....	8
How the beetle spreads.....	8
Seasonal history and habits.....	9
Feeding by adult beetle.....	12
Type of feeding.....	12
Factors influencing feeding.....	12
Toxic plants.....	14
Small fruits.....	14
Tree fruits.....	15
Truck and garden crops.....	15
Field crops.....	17
Ornamental herbaceous garden plants.....	19
Ornamental shrubs and vines.....	19
Shade trees.....	20
Noneconomic plants.....	21
Feeding by grubs.....	22
Natural enemies of the beetle.....	24
Native enemies.....	24
Imported parasitic insects.....	24
Entomogenous diseases.....	26
Fungi.....	26
Protozoans.....	26
Nematodes.....	26
Rickettsias.....	27
Bacteria.....	27
Status of the beetle in 1962.....	29



Growth Through Agricultural Progress

This handbook supersedes Circular No. 332, General Information on the Japanese Beetle in the United States

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# The **JAPANESE BEETLE** in the UNITED STATES

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The Japanese beetle *Popillia Japonica* Newm., one of our plant pests of foreign origin, was first found in the United States in 1916 in a nursery near Riverton, N.J. It was previously known to occur only in the main islands of Japan. Apparently it had come to this country with plants before restrictions on the importation of plants and plant products had been established by the Plant Pest Act of 1912.

The beetle is not a serious agricultural pest in Japan, where there are no large areas favorable for its reproduction and development, or the abundant supply of food it found in the eastern part of the United States, and its natural enemies are adequate to keep the beetle populations at a low level. In New Jersey it found a generally favorable climate, large areas of permanent turf for the development of the immature stages, almost 300 species of plants to satisfy its voracious appetite, and no important natural enemies.

Only about a dozen beetles were found in 1916. From this small beginning the beetle multiplied rapidly and spread until by 1962 it had invaded over 100,000 square miles in the eastern part of the United States, and it had become established in several isolated areas beyond this region of natural distribution. Soon after its establishment in this country the beetle demonstrated that it was a pest of major importance.

As the range of the beetle widens each year new groups of people will meet the invader for the first time. This handbook was prepared to acquaint such persons with the appearance, life history, habits, and economic importance of the insect, and with its native and imported natural enemies. The publication supersedes Circular No. 332, "General Information on the Japanese Beetle in the United States," which is now out of print. It does not tell in specific detail how to combat the beetle. Recommendations on the use of insecticides to protect plants from attack by the adult beetle and to destroy grubs in the soil are modified periodically as more effective materials are developed. The most recent information on measures for controlling the insect is given in Farmers' Bulletin No. 2151, "The Japanese Beetle—How To Control It."

## HOW TO RECOGNIZE THE JAPANESE BEETLE

### The Adult

The adult beetle (fig. 1) is a beautiful, broadly oval insect nearly one-half inch long and about one-fourth inch wide. The body is a bright metallic green; the legs, a darker green. The hard wing covers are a coppery brown and extend almost to the tip of the abdomen. There are two small tufts of white hairs just behind the wing covers and five patches along each side, which distinguish the Japanese beetle

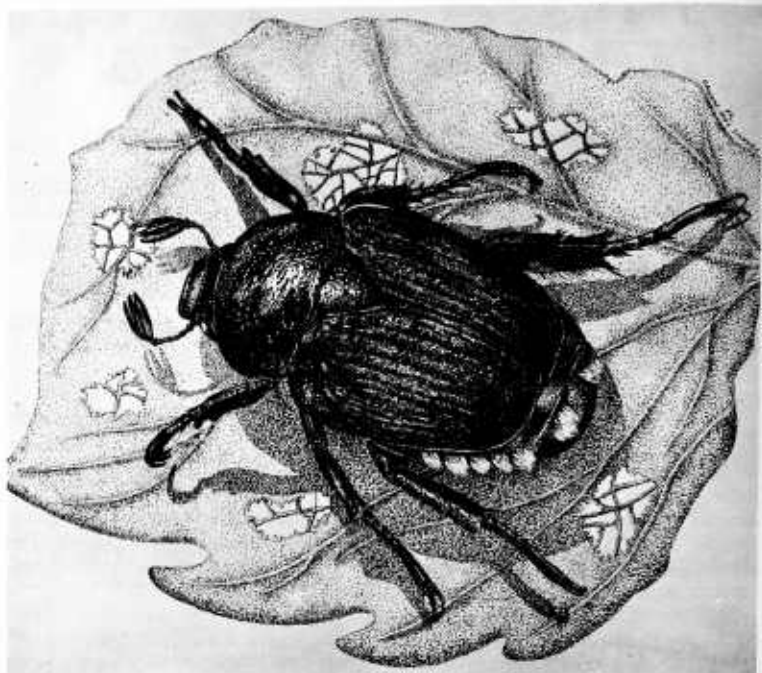


FIGURE 1.—The adult Japanese beetle. Five times natural size.

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from all other beetles that resemble it. The under surface of the body is clothed with short grayish hairs.

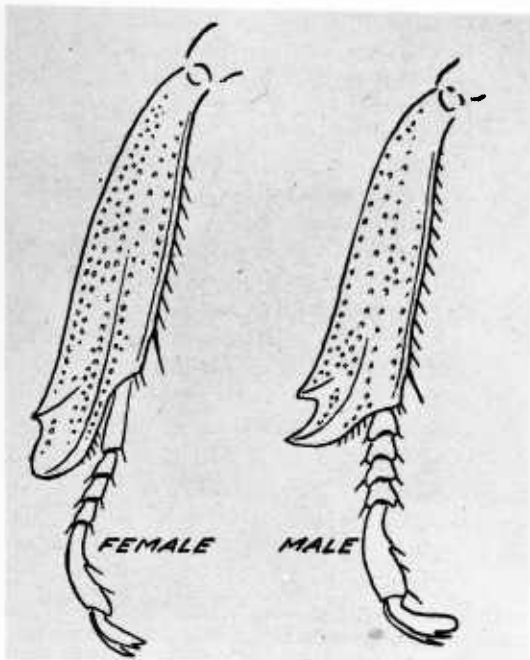
Both sexes have the same coloring and markings, but the males are usually slightly smaller than the females. The sexes can be distinguished by the structure of the first pair of legs. As shown in figure 2, the tibial spur of the male terminates in a sharp point, but on the female this spur is longer and obtusely rounded.

### The Egg

The egg of the beetle is elliptical in shape, and approximately one-sixteenth inch in diameter. It varies in color from a translucent to creamy white. The surface appears finely punctate under high magnification, the tiny punctures somewhat hexagonal in shape. After being in the ground for about a week, the egg begins to swell and eventually becomes about double its original size. At that time it is more spherical in shape and the developing embryo can be seen through the shell (fig. 3).

### The Grub

A completely white grub, about one-sixteenth inch long, emerges from the egg. Its head is equipped with biting mouthparts, each of the three thoracic segments bears a pair of legs, and there are ten



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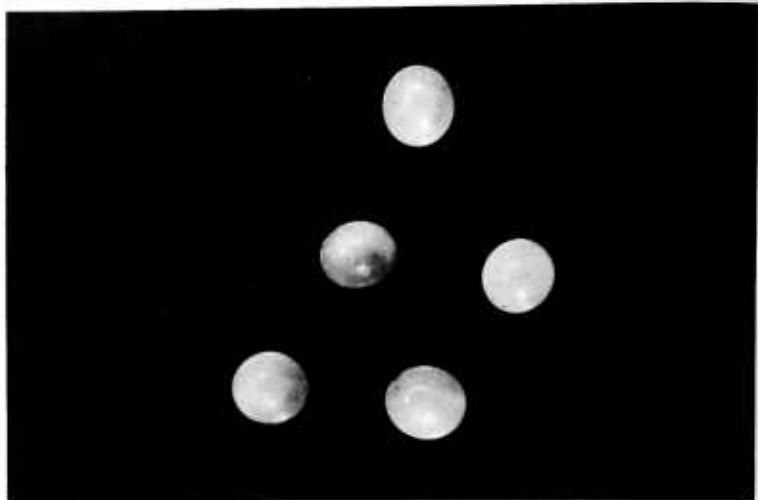
FIGURE 2.—Fore tibiae and tarsi of the Japanese beetle, greatly enlarged, showing the difference in structure between male and female beetles.

abdominal segments. The last two rows of spines on the underside of the last abdominal segment, or the anal plate, are arranged in the shape of a V (fig. 4), a characteristic that distinguishes this grub from all others. After a few hours, the color of the head changes to a yellowish brown. The grub is usually found in a cell in the soil, curled in the general shape of a crescent.

As the grub feeds on organic matter and fibrous roots, the accumulation of fecal matter in the hind gut gives the abdominal area a grayish to black appearance. The grub continues to feed and grow until it is about one-fourth inch long; then it is quiescent for about a day while it sheds its old skin. The second instar continues to grow until it is about one-half inch long; then it molts. By the time the grub is fully grown, it is about 1 inch long (fig. 5). When mature, the grub ceases to feed, and ejects any accumulated excrement. The body gradually becomes pale and shrunken in appearance. This is a semi-active condition between the active grub and the quiescent pupal stage.

### The Pupa

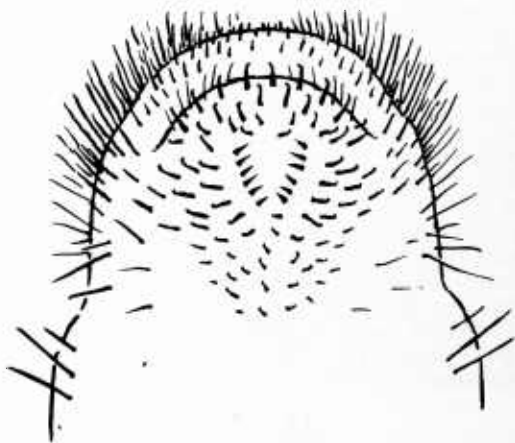
The grub transforms to a pupa within the old skin. The pupa (fig. 6) resembles somewhat the adult beetle, except that the legs, antennae, and wings are closely folded to the body. It is about one-



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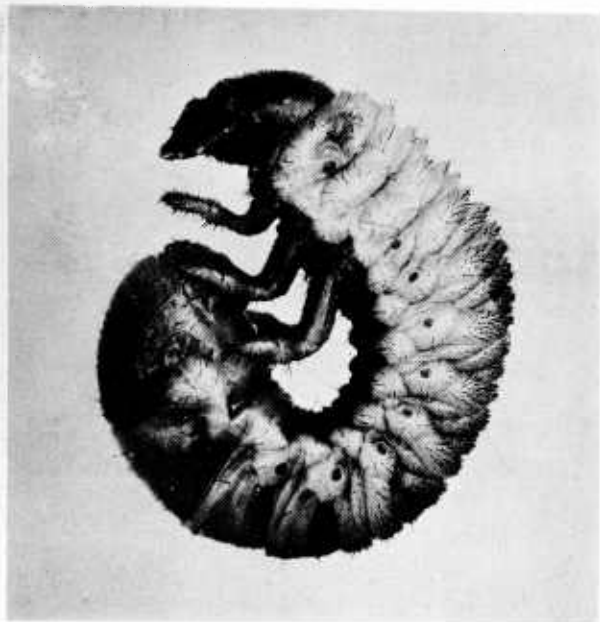
FIGURE 3.—Mature eggs of the beetle. Eight times natural size.

half inch long and one-fourth inch wide. The body, which at first is a pale cream color, gradually becomes a pronounced tan and finally the metallic green of the adult. When the transformation is completed, the adult beetle splits the enclosing skin and issues forth. It is soft and delicate at first, and usually remains in the earthen cell formed by the grub for several days before emerging from the ground.



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FIGURE 4.—Arrangement of hairs and spines on the underside of the last body segment of Japanese beetle grubs. The V-shaped arrangement of the last two rows of spines distinguishes this grub from all others.



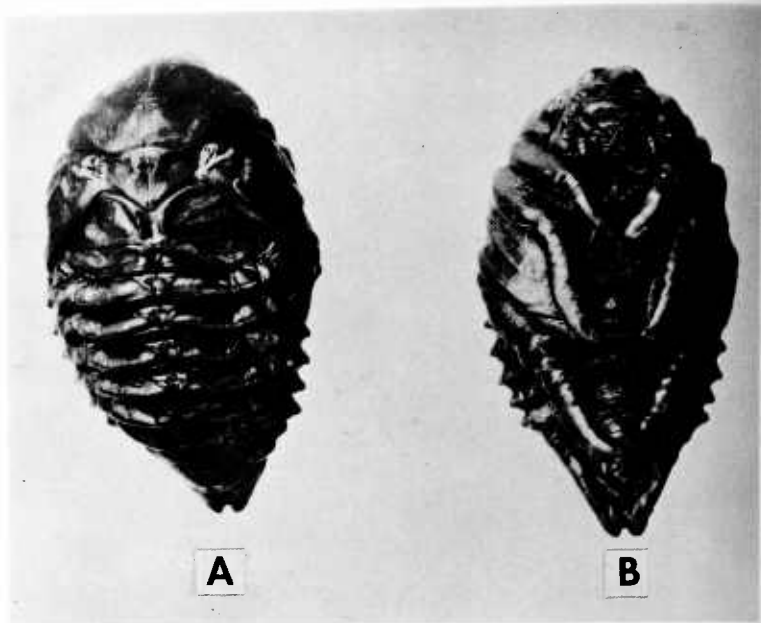
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FIGURE 5.—Full-grown Japanese beetle grub. Six times natural size.

## PRESENT DISTRIBUTION OF THE BEETLE IN NORTH AMERICA

During the five years following the discovery of a few beetles in 1916, the population increased rapidly and spread over an area of about 270 square miles in southern New Jersey and eastern Pennsylvania. This area increased to 3,200 square miles in 1926, to 6,200 square miles in 1931, to 12,500 square miles in 1936, to 20,000 square miles in 1941, to 37,500 square miles in 1946, to 60,600 square miles in 1951, to 94,000 square miles in 1956, and to over 100,000 square miles in 1962, when it extended from southern New Hampshire and Vermont into North Carolina and westward into Ohio and West Virginia, covering all or parts of 14 States and the District of Columbia. Local colonies of beetles have developed westward in Indiana, Illinois, Tennessee, Kentucky, Michigan, Iowa, Missouri, and California; southward in South Carolina, Georgia, and Florida; and northward in Maine, and in the Canadian Provinces of Ontario and Nova Scotia. Some of these colonies apparently have been eliminated by the application of insecticides to the soil, and insecticidal sprays to foliage, and other suppressive measures.

In the infested region along the Atlantic Seaboard the annual range of temperature is similar to that in the original home of the beetle in Japan. Precipitation is normally plentiful and uniformly distributed throughout the year. In some years the region is subjected to pro-



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FIGURE 6.—Pupae of the Japanese beetle. Six times natural size. A, Dorsal view; B, ventral view.

longed droughts during the summer, with more or less detrimental effect on the beetle populations, but it is questionable if the drought has been sufficiently severe in any part of the region to eliminate the insect. During dry summers the beetle selects low-lying, poorly drained tracts and irrigated land in which to deposit its eggs. When a dry summer is followed by one with adequate moisture, there is almost invariably an increase in the beetle population. The apparent permanent establishment of the beetle at many points throughout this region shows that, in general, the environmental conditions are suitable for its development.

## PROBABLE ULTIMATE DISTRIBUTION OF THE BEETLE IN NORTH AMERICA

The probable ultimate distribution of the beetle on the North American Continent is a matter of much interest and concern. It is believed that, apart from the ocean barrier, temperature and precipitation are the most important factors modifying the spread of the beetle beyond its present range.

### Temperature and Moisture Requirements of the Beetle

A temperature between 63° and 82° F. in the upper 3 inches of the soil is required for the eggs to hatch and the young grubs to develop



normally. There is some embryonic development at 54° F., but the eggs do not hatch. Eggs kept for the greater part of their development at 75° F. hatched at 54° F., but unless the young grubs were transferred to a temperature above 63° F., they died within a few days, probably because at 54° F. they were too sluggish to feed. Newly hatched grubs do not endure a temperature of 91° F. The second- and third-instar grubs develop normally at temperatures between 50° and 95° F.; they are practically dormant at temperatures below 50° F. The grub becomes progressively more cold-hardy as it develops. Third-instar grubs can endure a temperature of 15° F., providing the temperature of the soil is reduced slowly and thawing is gradual. Rapid freezing or thawing is fatal. Although grubs have transformed into pupae and emerged as adult beetles at temperatures of 55° and 95° F., many of the adults at these extremes of temperature were abnormal in that they were unable to shed the pupal skin entirely and the wings did not unfold.

A study during the summer months showed that the rainfall must be about 10 inches and uniformly distributed during that period for the eggs to hatch and the young grubs to develop normally in the soil. The egg must have moisture to bring about the swelling which is an essential prelude to embryonic development. The newly hatched grub must have adequate moisture to survive. It is more vulnerable to desiccation than the older grubs because its more lightly chitinized skin is less efficient in conserving body moisture, and it is less able to burrow deeper into the soil in search of moisture. A deficiency of rain during the summer invariably causes a reduction in the population developing in the soil. Rainfall deficiencies in the fall and spring are less important because the older grubs are more resistant to drought.

In most areas at present occupied by the beetle, the air temperature during the winter frequently ranges below the lethal temperature of 15° F., but the temperature below the surface of the soil is reduced only gradually below freezing. Precipitation indirectly affects the temperature of the soil. A blanket of snow serves to keep the temperature of the soil within a few degrees of 32° F., well within the cold tolerance of the grubs, even during prolonged periods of intense cold. On the other hand, a freezing rain on ground not covered by snow results in the formation of ice to a depth of several inches and causes a high mortality of the grubs.

## Western Spread of the Beetle

A study of the climatological data indicates that the beetle can spread westward naturally to about the 100th Meridian into North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. In parts of the central Mississippi River Valley, where rainfall during the summer averages from 2 to 4 inches less than on the Atlantic Seaboard, and droughts tend to be more frequent and severe, the beetle may have some difficulty in becoming established, and populations are likely to increase slowly. The grubs probably could not survive the winter in much of Wisconsin, Minnesota, North Dakota, and South Dakota, and in northern Iowa and northeastern Nebraska because of the very low temperatures and the light precipitation. In that area the temperature in the soil normally goes below the fatal 15° F. during the winter.

West of the 100th Meridian to the higher mountain ranges the country is too dry during the summer for the beetle to survive. In the western mountain ranges precipitation is adequate but the summers are too cool for development of the insect.

The cool summers and generally scanty rainfall in Washington and Oregon are not favorable for the beetle. In central and southern California temperatures are favorable throughout the year, but the low precipitation during the summer would prevent the beetle from becoming established, except in irrigated areas.

### **Southern Spread of the Beetle**

There seems to be no climatological barrier to the spread of the beetle into Florida and along the Gulf Coast into Alabama, Mississippi, Louisiana, and eastern Texas. In tropical and subtropical Florida, where the temperatures are well within the limits for development of the insect, and rainfall is copious, the beetle would not only be able to survive; there probably would be two generations a year.

### **Northern Spread of the Beetle**

The northern limits of spread of the beetle in the eastern half of the United States will probably be in the more elevated sections of northern New England and New York and in northern Michigan. In these areas, the low temperatures of late spring and early summer would so retard development of the insect that emergence and egg deposition could hardly occur before August 1. Although the eggs might hatch, it is unlikely that the grubs could survive. Elsewhere along the Canadian border the beetle could spread in the southern parts of the Provinces of Ontario and Quebec, into the interior to Georgian Bay, and along the St. Lawrence River to Montreal. In southern New Hampshire, Vermont, and Maine, where the beetle is established, some of the grubs require 2 years to mature and complete their life cycle.

Even in those areas where the temperature and precipitation are favorable for the beetle, there may be some ecological factor that would inhibit its development. The grubs thrive in soils where the pH is between 4.0 and 6.0; the populations are reduced in alkaline soils. They develop better in well-drained loams and sandy loams than in the heavy clay loams or the sands. The vegetation also influences the buildup of populations. The beetle tends to become well established and increase in abundance in those areas devoted to grazing, general agriculture, truck crops, and fruit growing; it does not invade heavily forested land, but it may be found in open spaces in the woods.

### **HOW THE BEETLE SPREADS**

The adult beetle is a strong and vigorous flier. It is especially active on warm, sunny days. Beetles usually fly short distances from plant to plant and from place to place in search of suitable food. It is not uncommon for them to fly one-half mile or more against the wind from a pasture to an orchard of ripening fruit. Very little flying occurs when high winds are blowing, or on rainy days.

Occasionally there have been mass flights of beetles from the infested area. For several years there were flights across the Delaware

River from New Jersey into the downtown shopping and market districts of Philadelphia, Pa. It is not known how far a beetle can fly in sustained flight. In 1929, when the population reached its peak in southern New Jersey, millions of beetles flew out to sea and annoyed fishing parties even 5 miles offshore. Later, they were washed up dead and dying in windrows on the beaches of the shore resorts. Beetles have been observed in flight several hundred feet above the ground; when flying with the wind such beetles could be carried long distances.

After periods of heavy rain beetles have been observed floating down streams on pieces of wood and other debris. Beetles are able to float on water for several hours. In 1933 many beetles were carried by wind from New Jersey out over lower Delaware Bay. Many of them dropped into the water. After falling into the water, they drifted about until washed up on the opposite shore in Delaware. Beetles have floated across New York Bay from New Jersey to Long Island.

In the progressive spread of the infested area during the period from 1921 to 1962, the beetles moved outward each summer at a rate of 5 to 10 miles a year.

There is always danger of beetles being carried long distances to uninfested areas by automobiles, boats, freight and passenger trains, and airplanes. Beetles have been carried from the east coast to the west coast in a few hours by jet plane. They fly into these transportation facilities during the process of loading; or passengers may carry them on their clothing or baggage. Adult beetles may be transported in containers of fruit or vegetables and other agricultural commodities. The eggs and grubs may be carried in soil about the roots of plants. Quarantines have been in force for many years to restrict this artificial dispersion of the beetles. That dispersion of the beetle has not been more widespread in the United States during the past 45 years may be credited to the enforcement of restrictions of the Federal and State quarantines on the movement of various carriers and products.

## SEASONAL HISTORY AND HABITS

Normally the beetles begin to emerge from the soil the third week of May in central North Carolina; the first week of June in Virginia; about the middle of June in Maryland and Delaware; the third week of June in New Jersey, Ohio, West Virginia, and southeastern Pennsylvania; the last week of June in New York, Connecticut, Rhode Island, and Massachusetts; and the first week of July in southern Maine, southern Vermont, and southern New Hampshire. On reaching the surface of the ground, the beetles usually fly to, or climb on, some low-growing plants nearby and begin to feed. Mating of the sexes may occur soon after emergence and is repeated at frequent intervals throughout the life of the individual, which is usually 30 to 45 days. Mating usually takes place on plants, but it may occur on the ground. When the population is dense, several males may attempt to copulate with a female as soon as she emerges from the ground. The congregated mass of beetles resembles an animated ball; each mass is composed of a single female and from 25 to 300 male beetles.

On warm, sunny days the beetles feed and fly vigorously. They are naturally gregarious, and tend to collect and feed on certain plants,

leaving other plants of the same variety, apparently equally attractive, untouched. Late in the afternoon the females usually enter the ground to lay their eggs; they may come out of the ground the following morning or remain in the soil for 3 or 4 days. They prefer to lay their eggs in moist, loamy soil covered with closely cropped grass such as in lawns or pastures, but some eggs are deposited in cultivated areas. During periods of drought the female beetle seeks the moist, more friable spots to lay her eggs; most of the eggs may then be deposited on the watered greens of golf courses rather than over the course, and in cultivated fields rather than in dry, hard pastures. After burrowing to a depth of 1 to 4 inches, the female deposits 1 to 4 eggs at one time, and after an indefinite period in the soil, she returns above ground to resume feeding. This procedure goes on until 40 to 60 eggs have been laid. The peak of the beetle population in an area is usually reached 4 to 5 weeks after the initial emergence, but since some individuals emerge later than others, beetles may be present in an area for 4 months, or until frost.

The eggs hatch about 2 weeks after they are laid. The grub forms a cell in the soil slightly larger than its body and feeds on fine rootlets. It usually follows the course of the rootlets until these are consumed. The grub passes through three stages, or instars, before reaching maturity. The change from one instar to the next is accompanied by a shedding or molting of the skin. The first molt usually occurs 2 to 3 weeks after the young grub emerges from the egg; the second molt, 3 to 4 weeks later. Most of the grubs are full grown in the fall, and reach maturity in the spring. Then, after spending about 10 days in the inactive prepupal condition, they change to the quiescent pupal stage within their earthen cells. This stage lasts 8 to 20 days, depending upon the temperature and other conditions. The final transformation then takes place, and the adult beetles emerge from their pupal skins and make their way to the surface of the ground. The entire life cycle in southern New Jersey, which is shown diagrammatically in figure 7, requires 1 year. In the northern infested areas, some grubs require 2 years to complete their life cycle; in the extreme southern areas, there is a possibility of two generations a year.

In southern New Jersey the beetle population in the soil is dominantly eggs in July, first- and second-instar grubs in August, second- and third-instar grubs in September, third-instar grubs from October to May, and third instars, prepupae, and pupae in June. Further information on the average composition of this population over an 11-year period is given in table 1. The development of the population is accelerated in the southern parts of the infested area, and retarded in the northern parts.

During the summer and early fall the grubs feed mostly within the upper 3 inches of soil; in lawns and pastures they are close to the surface of the ground. When the mean temperature of the soil near the surface falls to about 60° F., some of the grubs begin to move downward; movement ceases when the soil temperature reaches 50° F. During the winter about two-thirds of the grubs are found within the upper 4 inches, and less than one-twentieth of them below 6 inches. They tend to go somewhat deeper in cultivated fields than in permanent turf, probably because the soil is looser and easier to dig through, and the roots of the plants go deeper. In the spring as the soil becomes warmer the grubs move upward to the 3-inch layer and resume feeding.

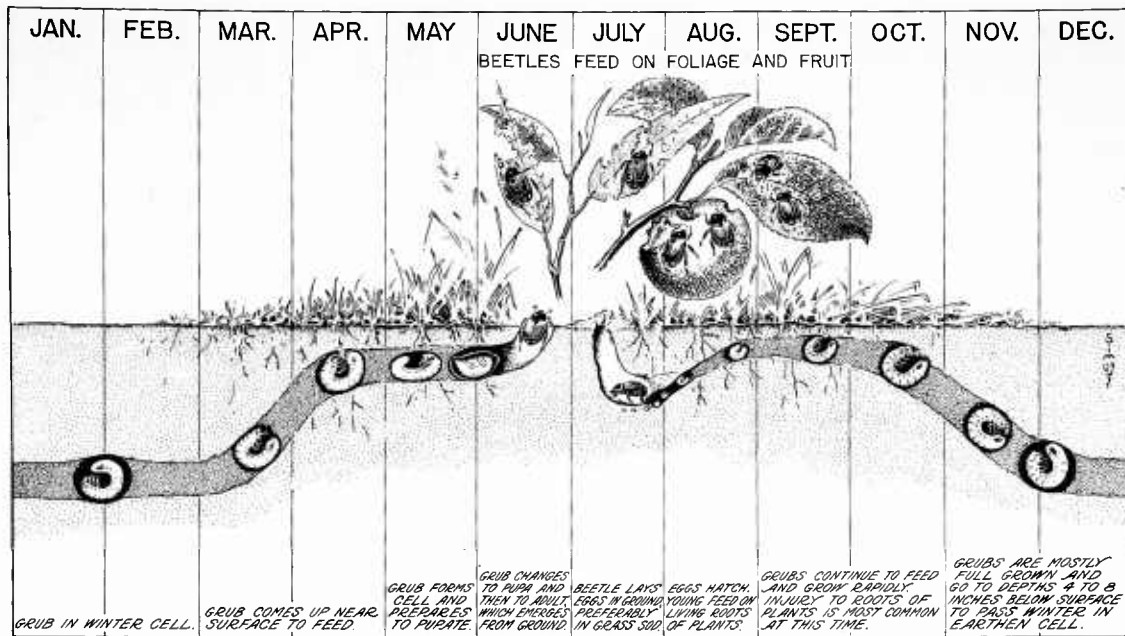


FIGURE 7.—Seasonal life cycle of the Japanese beetle in southern New Jersey.

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TABLE 1.—*Composition of the beetle population in soil in southern New Jersey throughout the year*

Month	Percent of population as—						
	Egg	Grub			Prepupa	Pupa	Adult
		1st instar	2d instar	3d instar			
July	55	15	1	3	2	9	15
August	8	31	55	6	—	(*)	(*)
September	(*)	2	29	69	—	—	—
October	(*)	(*)	7	93	—	—	—
November-March	—	—	7	93	—	—	—
April	—	—	6	94	—	—	—
May	—	—	5	95	(*)	(*)	—
June	1	—	(*)	40	25	28	6

\*Less than 1 percent.

## FEEDING BY ADULT BEETLE

### Type of Feeding

In feeding on the foliage of most plants, the beetles chew out the tissue between the veins, leaving a lacelike skeleton, as shown in figure 8. On some plants with thin leaves and fine venation, and on petals of roses and other flowers, where the delicate veins are not unpalatable, the beetles cut out and consume large, irregularly shaped portions in the same manner as a caterpillar. Plants with thick, tough foliage are usually free from attack, but when such leaves are eaten, the feeding is restricted to nibbling on the upper surface and does not penetrate to the lower surface of the leaf. Severely injured leaves soon turn brown and drop.

### Factors Influencing Feeding

The beetles are most active and feed most extensively on warm, clear, summer days between 9 a.m. and 3 p.m. Early in the morning they are usually resting quietly on the plants, although some slight feeding may occur at that time. When the temperature reaches about 70° F., they begin to fly in all directions and to collect on the more favored plants in the vicinity. Feeding is heaviest at temperatures between 85° and 95° F. The beetles become inactive at temperatures above 95° F., and often seek shade by crawling to the underside of leaves. A relative humidity above 60 percent retards flying and induces the insect to feed extensively. Late in the afternoon feeding and flying slacken and the beetles become quiet for the night. There is little feeding or flying on cool, windy days or on cloudy days, and no activity on rainy days. The beetle is very responsive to a change in the weather; a passing cloud will cause a beetle in flight to seek a suitable resting place immediately.



J-1103b

FIGURE 8.—Leaves of Norway maple destroyed by feeding of the Japanese beetle. The soft tissue has been eaten, leaving the network of veins.

The beetles prefer to feed on plants exposed to the direct rays of the sun. Plants in shade are never fed on so heavily as those in the sun. Plants in close-growing woods are rarely attacked. Usually the beetles begin to feed on the upper and outer foliage and work downward. By the time one-half to two-thirds of the foliage on a tree has been consumed, the beetles may leave and congregate on other plants in the vicinity, or they may continue to feed until the tree is completely defoliated.

The attractiveness of various plants to the beetle changes during the summer. When beetles first emerge in an area, feeding is usually confined to low-growing plants such as roses, zinnias, smartweed, sassafras, and grapes, and there is much flying from plant to plant. In areas of dense population, feeding on these plants may continue until practically all of the foliage has been consumed. However, about 2 weeks after the initial emergence, the beetles tend to leave the low-growing plants and go to the fruit and shade trees. They may feed on the trees for several weeks, but as the leaves become older and tougher, they return to the more-succulent, low-growing plants. Most of the damage to asparagus, corn, clover, and other succulent plants occurs after the beetles have left the trees.

In general, the degree of feeding on any plant will depend upon its attractiveness to the insect and upon the abundance of beetles in the vicinity. It is not known why some species of plants are preferred and other closely related species are practically free from attack.

Beetles are attracted to succulent flowers and foliage, but all succulent plants are not attacked. They are attracted by ripening fruit and to plants with a high content of reducing sugar. When there are only a few hundred beetles in the vicinity, the beetles attack usually only the most preferred plants, but when several million are present, the feeding is on all favored plants, and on those rarely attacked.

## Toxic Plants

The public has called attention from time to time to plants that were believed to be toxic to the beetle. The usual evidence was the presence of a large number of dead beetles on the ground beneath a plant on which they had been feeding. After mid-summer when many beetles have lived their normal span of life, it is not uncommon to find dead beetles beneath all plants on which they are feeding. In most cases it was not possible to demonstrate experimentally that the plants had constituents toxic to the beetle. A few plants were found to have some toxicity to the insect.

Beetles feed readily on the flowers and foliage of cultivated geraniums, *Pelargonium* spp., and often become paralyzed and drop from the plants. Some die, but many recover within 24 hours. The flowers are more toxic than the foliage; plants in sunlight have a higher toxicity than those in the shade.

The castorbean, *Ricinus communis*, is not one of the most favored plants. The beetle attacks the foliage and flowers of the varieties Sanguineus and Zanzibariensis, but it has not been observed feeding on the other varieties. These two varieties appear to be mildly toxic to the beetle.

The flowers of the bottlebrush-buckeye, *Aesculus parviflora*, are very toxic to the beetle, but the foliage has little toxicity. If the beetles feed long enough on the flowers, they become paralyzed and eventually die. The buckeye is in bloom when the beetles are in flight; the horsechestnut, *A. hippocastanum*, is in bloom before the beetles appear. It is possible that the flowers of horsechestnut are toxic to the beetle.

## Small Fruits

The fruit and foliage of blackberries, huckleberries, blueberries, and raspberries are eaten by the beetle. The injury to one-crop varieties of raspberries such as Latham is not usually of economic importance, but the feeding on the growing tips of Ranere and other two-crop varieties may reduce seriously the second crop. Ripening blueberries are attacked vigorously; after the fruit is harvested, the feeding continues on the new succulent foliage.

The foliage of all varieties of grapes is preferred food for the beetle; the foliage is frequently skeletonized (fig. 9). The beetle attacks the fruit of such early-ripening varieties as Clinton, Delaware, Niagara, Muscat, and Portland, but it usually does not damage the immature fruit of late-ripening varieties. However, unless the grape berry moth and black rot are controlled in a vineyard, the beetle is likely to attack even the immature berries.

The beetle feeds on the foliage of red currant, cranberry, and strawberry, but the damage usually is not of economic importance. It rarely attacks gooseberries.





FIGURE 9.—Japanese beetles feeding on a grape vine.

J-3443

## Tree Fruits

The foliage of apple, cherry, and plum is very attractive to the beetle; feeding is often extensive on these trees. The foliage of peach, nectarine, and quince is less attractive, but considerable damage may be done. Pear and persimmon trees are rarely attacked. Ripening or diseased fruit is particularly attractive to the beetle; the foliage of trees with such fruit is eaten more extensively than that of trees with sound immature fruit, or without fruit.

Crops that mature before or after the beetles are abundant in an area are not usually injured seriously. Cherries are often picked before many beetles appear. There are few beetles around to injure the maturing fruits of late-ripening peaches and apples.

The fruits of apple, peach, nectarine, plum, and quince, that mature when the beetle is abundant, are often damaged seriously. Very little feeding is sufficient to lower the market value of the fruit, but at times the beetles gather on the fruits in such large numbers as to cover them completely (figs. 10 and 11) and feed until nothing edible is left. The beetle is very fond of such apples as Yellow Transparent, Starr, Williams, and Red Astrachan. The injury is most severe on peaches of the Cumberland, Raritan Rose, Triagem, and Sunhigh varieties; moderate on Redrose, Goldenglobe, Summercrest, and Goldeneast; and light on Elberta.

## Truck and Garden Crops

Corn is one of the preferred plants of the beetle. The leaves and tassels are sometimes eaten, but the silks of both field corn and sweet corn are highly attractive. Masses of beetles collect on the maturing silk and cut it off as it grows (fig. 12); this prevents the pollination of many embryonic kernels and results in malformed kernels and reduced yield.



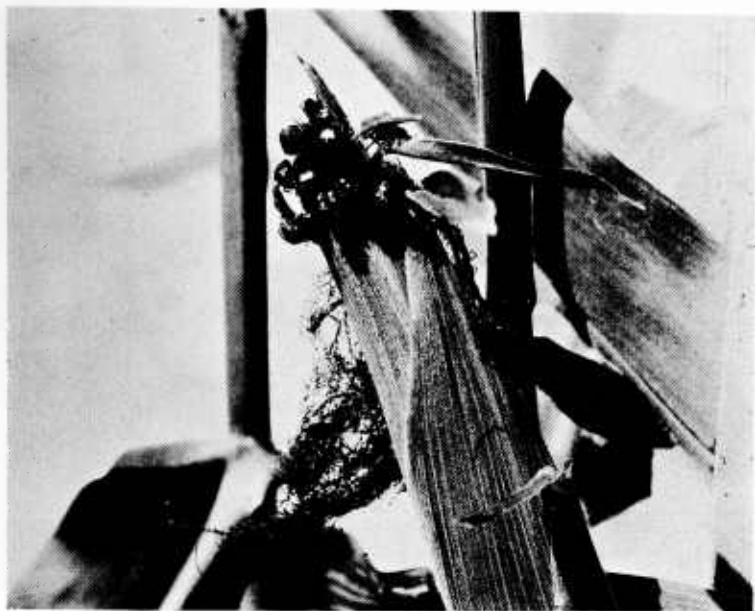
J-3049

FIGURE 10.—Japanese beetles feeding on the fruit and foliage of peach.



J-7601

FIGURE 11.—Japanese beetles feeding on the fruit and foliage of apple.



J-728

FIGURE 12.—Japanese beetles feeding on the silk of corn.

The beetles feed extensively on asparagus and do much damage to the young leaflets and to the epidermis of the branches and stalks. Several hundred beetles sometimes collect on a single plant and bend it over by their weight (fig. 13). Extensive feeding weakens a plant and reduces the yield the following spring.

Beetles often feed heavily on the leaves of rhubarb (fig. 14). At times the foliage of lima beans and bush beans is severely attacked. The feeding is usually light on okra, beets, broccoli, cabbage, brussels sprouts, white mustard, turnip, endive, watermelon, cantaloupe, cucumbers, pumpkin, squash, artichoke, carrots, sweetpotato, garden peas, eggplant, salsify, parsley, and catnip. The beetle rarely attacks onions, leek, cauliflower, rutabaga, kale, redpepper, lettuce, tomato, radish, or spinach.

### Field Crops

Field corn and soybeans (fig. 15) are the only field crops severely damaged by the beetle. The soybean varieties Richland, Earlyana, Lincoln, and Mingo are usually the most attractive, and Chief, Illini, Gibson, and Viking the least attractive, but the varietal preferences of the beetle may change from year to year and from place to place. Beetles feed moderately on the foliage and blooms of alsike clover, red clover, and alfalfa, and lightly on whiteclover. They rarely attack timothy, buckwheat, oats, barley, rye, millet, wheat, tobacco, potatoes, or vetch.



J-2822

FIGURE 13.—Japanese beetles feeding on asparagus plants.



J-2896

FIGURE 14.—Japanese beetles feeding on rhubarb.



FIGURE 15.—Japanese beetles feeding on soybeans

J-3718

## Ornamental Herbaceous Garden Plants

The beetle is very fond of the blooms of hollyhock, dahlia, marsh-mallow, rosemallow, common mallow, evening-primrose, white thorough-wort, and zinnia. It feeds lightly to moderately on corn-cockle, calendula, canna, gladiolus, sunflower, flower-of-an-hour, St. Johns-wort, morning-glory, cardinal-flower, four-o'clock, lotus, yellow oxalis, peony, garden geranium, Japanese fleecflower, castorbean, scarlet sage, marigold, bracken, and cinnamonfern. It rarely attacks asters, chrysanthemum, oxeye daisy, pampasgrass, cosmos, gaillardia, gardenia, strawflower, daylily, iris, purple loosestrife, beebalm, petunia, phlox, spiderwort, or verbena. It has not been observed feeding on ageratum, snapdragon, columbine, wild-indigo, begonia, caladium, cockscomb, dusty-miller, cornflower, mountain-bluet, turtlehead, lily-of-the-valley, coreopsis, crassula, larkspur, sweet-william, clover pink, bleedingheart, foxglove, California poppy, Iceland poppy, Chile-avens, gypsophila, coralbells, plantainlily, candytuft, garden balsam, lantana, perennial peavine, sweetpea, forget-me-not, flowering tobacco, lions-heart, portulaca, mignonette, coneflower, scabious, sedum, nasturtium, mullein, speedwell, violet, or pansy.

## Ornamental Shrubs and Vines

The rose (fig. 16) is perhaps the most attractive of the ornamental shrubs to the Japanese beetle. Not only are the fully developed flowers unusually attractive to them, but the buds, as soon as they show



J-2726

FIGURE 16.—Japanese beetles feeding on a rose bush.

the color of the petals, are also subject to attack. Beetles feed on the blooms and foliage of roses throughout the summer. Usually the white and yellow roses are damaged more extensively than those of darker hues. The beetles also severely damage bottlebrush-buckeye, summersweet, shrub-althea, kerria, crapemyrtle, Japanese flowering-crab, Japanese plum, Oriental cherry, Virginia-creeper, and Japanese-creeper. They feed lightly to moderately on aralia, Hinodegiri azalea, spicebush, Japanese barberry, European barberry, trumpetcreeper, butterfly-bush, buttonbush, flowering quince, deutzia, weigela, pearl-bush, wisteria, lespedeza, California privet, bayberry, kudzu vine, spirea, and viburnum. They feed rarely on ailanthus, torch azalea, Chinese azalea, swamp-azalea, clematis, English ivy, climbing hydrangea, winterberry, European privet, honeysuckle, matrimony-vine, rhododendron, elder, or European bush-cranberry. Beetles have not been observed feeding on bamboo, common box, beauty-berry, sweet-shrub, American bittersweet, Chinese redbud, dogwood, evergreen-euonymus, forsythia, smooth hydrangea, panicle hydrangea, American holly, mountain-laurel, mockorange, Japanese pieris, American bladder-nut, snowberry, coralberry, lilac, or tamarisk.

### Shade Trees

The beetles feed extensively on Japanese maple, Norway maple, horsechestnut, gray birch, American chestnut, black walnut, London planetree, Lombardy popular, pussywillow, American mountain-ash, American linden, littleleaf linden, European linden, American elm, English elm, and Chinese elm, and when abundant may practically defoliate the trees. They feed lightly to moderately on sycamore maple, sugar maple, black alder, white birch, mockernut hickory, southern catalpa, hawthorn, American beech, European beech, Carolina silverbell, Siebold walnut, European larch, tupelo, American

planetree, scrub oak, chestnut oak, pin oak, weeping willow, heartleaf willow, bald-cypress, silverpendent linden, silver linden, and slippery elm. They rarely attack boxelder, pignut hickory, shagbark hickory, American hazelnut, smoke tree, cryptomeria, ginkgo, witch-hazel, butternut, Chinese juniper, common juniper, eastern redcedar, American sweetgum, Virginia pine, white oak, scarlet oak, post oak, eastern red oak, southern red oak, black oak, locust, American arborvitae or Oriental arborvitae.

The beetles have not been observed feeding on white fir, red maple, silver maple, false cypress, white ash, green ash, tulip tree, southern magnolia, sweetbay magnolia, red mulberry, Norway spruce, Oriental spruce, Colorado spruce, Scotch pine, eastern white pine, white poplar, or Canada hemlock.

### Noneconomic Plants

If the beetle did not have fruit, cultivated crops, and ornamental plantings available, it could make out well on the numerous weeds and other plants of little value. Pennsylvania smartweed (fig. 17), sassafras, poison ivy, summer grape, and fox grape are very attractive to them. If beetles are in an area where these plants grow, they are more apt to feed on them than on other wild plants, particularly early in the summer. They feed lightly to moderately on velvetleaf, copperleaf, ragweed, dogbane, partridgepea, chicory, crabgrass, fleabane, bedstraw, snapweed, butter-and-eggs, toadflax, spatterdock, Virginia arrow-arum, broadleaf tearthumb, cornbind, hedge knotweed, marsh-pepper smartweed, princesplume, ladysthumb, spotted ladysthumb, hedge cornbind, pickerelweed, chokeberry, curly dock, bitter dock, shining sumac, meadowbeauty, arrowhead, goldenrod, cattail, and ironweed. They also feed occasionally on amaranth, milkweed, lambs-



FIGURE 17.—Japanese beetles feeding on smartweed.

J-2721

quarters, goosefoot, Canada thistle, flat-sedge, joe-pye-weed, quickweed, tickclover, plantain, staghorn sumac, greenbrier, and germander.

## FEEDING BY GRUBS

The grubs feed on the roots of a wide variety of garden and field crops, ornamental plants, and grasses, but they do not thrive in plantings of whiteclover, red clover, alsike, sweetclover, alfalfa, soybeans, buckwheat, or orchard grass. The feeding of the grubs on the underground stems and roots may not be suspected until the plants are badly damaged.

The grubs are most abundant in well-kept lawns, and in pastures and golf courses. They prefer the tender grasses to the tougher varieties of grass and other plants. As a grub burrows through the soil just below the surface, it cuts off and consumes the grass roots. When there are more than 10 grubs per square foot of turf, and there is a deficiency of rainfall, there may be several areas of dead brown grass in the sward by September or early October (fig. 18), that can be rolled back easily with the fingers (fig. 19), but the damage may not appear until the following spring.

If there is a limited supply of food, as in cultivated fields, the grubs move about considerably, and may travel laterally as much as 10 feet. They tend to collect about the roots of plants; very few are found in unplanted spots. When there is a dense population, the grubs damage seedling corn, beans, cabbage, tomatoes, and other truck and garden crops. Extensive feeding on the roots of even well-established plants reduces their vitality and may affect the yield. Grubs have destroyed many plants in nursery seedbeds, and have killed 50 percent or more of the plants in strawberry beds. They also severely injure some varieties of ornamental nursery stock by girdling the main roots at depths of one-half to one and one-half inches below the surface of the ground, and consuming the roots (fig. 20).



J-2392

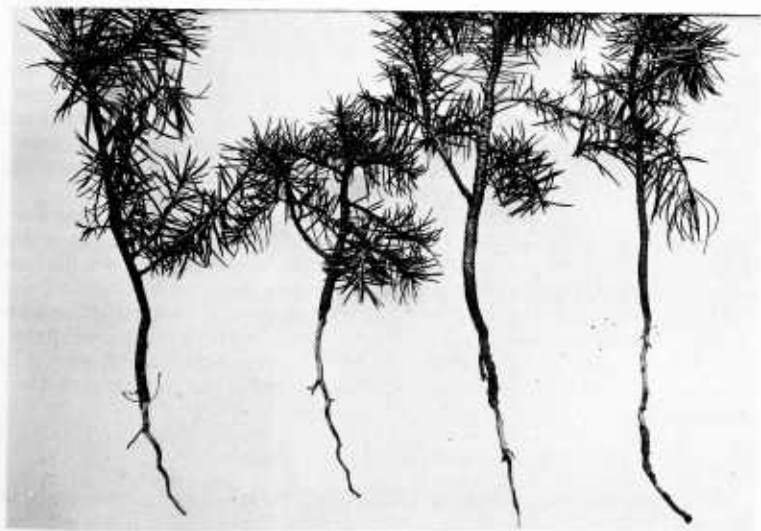
FIGURE 18.—A lawn damaged by the feeding of Japanese beetle grubs on the roots of grass.





J-2010

FIGURE 19.—Japanese beetle grubs exposed when injured turf is rolled back.



J-341

FIGURE 20.—Plants killed by the feeding of Japanese beetle grubs on their roots.

# NATURAL ENEMIES OF THE BEETLE

## Native Enemies

When the beetle became established in New Jersey, the insect-feeding birds, small terrestrial animals, and the few predaceous and parasitic insects indigenous to the region were not sufficient to cope with its 20- to 30-fold reproductive potential.

Chickens, ducks, turkeys, and guineas, and a few wild birds among which are the purple grackle, the European starling, the cardinal, the meadow lark, the catbird, the house sparrow, the robin, and the ring-necked pheasant feed on adult beetles. The domestic fowl, the European starling, the purple grackle, the crow, and gulls also dig and devour large numbers of grubs, especially when fields are being plowed and when grubs are close to the surface in grasslands.

Toads eat a great many beetles. Among the terrestrial mammals, the common mole, the star-nosed mole, the short-tailed shrew, the skunk, and possibly the pine mouse feed on grubs. The predaceous ground beetles, the horse-flies, and the stiletto-flies will attack the grubs when they encounter them, and robber flies and ants have been observed feeding on both adults and grubs.

Practically none of the native parasitic insects attack the beetle. The wasp *Tiphia intermedia* Mall. sporadically parasitizes a small proportion of the grubs, and a fly, *Ptilodexia* sp., has been observed attacking them. Although these native enemies have, from time to time, reduced the beetle population within a limited area, their efforts are too sporadic and too restricted to have much effect on the population within a region.

During the first 12 years following discovery of the beetle, the annual populations in southern New Jersey increased rapidly in magnitude and importance. In some places the turf had a population of 150 grubs per square foot. When the population reached its peak density in that area in 1929, it was estimated that there were more than 500 million adult beetles per square mile. Then, the annual populations began to decline until by 1945 the beetle was of only minor economic importance in southern New Jersey, except in a few isolated areas. This cycle of rise and decline in population has been repeated, with modifications, as the beetle has invaded new areas.

When the beetle population began to decline in southern New Jersey, it was thought at first that the reduction might be due to a deficiency of rainfall at the time the eggs were hatching, but the decline continued even when rainfall was favorable for development of the grubs. It was evident that some other factor was restoring the biological balance in the region. Two new biotic agents—imported parasitic insects and native diseases—were becoming established, and it is known now that they were largely responsible for the progressive decimation of the beetle population.

## Imported Parasitic Insects

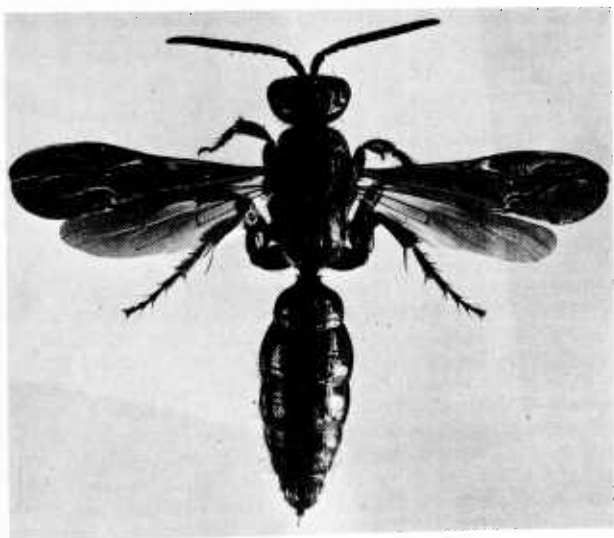
A search for the enemies of the beetle in Japan and elsewhere was carried on from 1920 through 1933. It was found that a large number of insect parasites and predators attack the various stages of the Japanese beetle and related species in the Orient. During that period 1½ million predaceous and parasitic insects of 49 species were collected

in Japan, Korea, Formosa, China, India, Australia, and Hawaii, and shipped to the Department's laboratory in New Jersey.

Five of the imported parasitic insects have become established in the eastern United States and are a part of the permanent fauna of the region. These species are *Hyperctetina aldrichi* Mesnil. (*Centeter cinerea* Ald.), a parasite of the adult beetle, and *Dexilla ventralis* (Ald.), *Prosema siberita* (F.), *Tiphia popilliavora* Rohw, and *Tiphia vernalis* Rohw. which parasitize the grubs. The most effective and widely distributed of these species are *T. vernalis* (fig. 21), which attacks overwintering grubs in the spring, and *T. popilliavora*, which parasitizes the grubs of the new brood in late summer.

The female *Tiphia* wasp searches out a grub in the soil, stings it to cause temporary paralysis, and attaches a single egg to its underside. The maggotlike larva hatching from the egg remains attached to the grub, sucking blood and feeding on it. The young parasite attains full growth within a few days, by which time the grub has been consumed except for the head capsule. The parasite larva then spins a strong, watertight, silken cocoon within the earthen cell formerly occupied by the grub and the following year emerges as an adult.

Under favorable conditions *T. vernalis* has parasitized over 60 percent of the grubs in an area; *T. popilliavora* is somewhat less effective. There is no doubt that these two wasps have important parts in the biological control of the Japanese beetle. The other imported parasitic insects have a lesser role.



J-2932

FIGURE 21.—*Tiphia vernalis*, a wasp that lives on and destroys Japanese beetle grubs. About six times natural size.

## Entomogenous Diseases

Diseases were found occasionally among Japanese beetle grubs as early as 1921. Although these diseases were not identified specifically, they were determined to be mainly of bacterial and fungous origin. By 1933 large numbers of infected grubs were found in certain areas in New Jersey, Delaware, and Pennsylvania. About 25 different soil microorganisms can infect some stage of the Japanese beetle; among these are fungi, protozoa, nematodes, and bacteria.

### Fungi

*Metarrhizium anisopliae* Metsch., the green muscardine, was found attacking Japanese beetle grubs in 1921. Since then grubs infected with this fungus have been found from time to time throughout the beetle-infested area. Although this fungus is widely distributed naturally, the incidence of infection among the grubs is usually low. There is no doubt that the sporadic and small but continuous occurrences of this disease among the grubs have a beneficial effect, even though they may rarely bring the beetle under control.

*Metazhizium glutinosum* Pope is also pathogenic to the grubs. This fungus probably has about the same limitations as *M. anisopliae*.

*Isaria densa* Auct., a pathogen of *Melolontha* spp. in France, infected grubs introduced into inoculated soil under experimental conditions, but the disease has not been used successfully in the field.

The spores of *Beauveria bassiana* (Bals.) Vuill. appear to have little pathogenicity to the grubs, but adult beetles allowed to feed on foliage sprayed with a dilute suspension of spores become infected. Healthy beetles kept in close association with infected beetles soon contract the disease. Although this disease occurs sporadically in areas where the fungus was colonized, it is probably of little importance in the control of the beetle.

### Protozoans

In 1950 Japanese beetle grubs infected with a microsporidian were found at Warrenton, Va., but since then no cases of this disease have been found there, or elsewhere within the beetle-infested area. The possibilities of a microsporidian disease for the control of the beetle have not been investigated.

### Nematodes

In the spring of 1929, Japanese beetle grubs infected with a nematode, *Neosaplectana glaseri* Steiner, were found at Haddonfield, N.J. Later parasitized pupae and adult beetles were found in that area. Since *N. glaseri* is a general parasite of insects, but not pathogenic to plants, it appears that it had adapted itself to the Japanese beetle. Although a search was made in other parts of New Jersey and in Pennsylvania, it was not found at that time in any other area.

The infective, second-stage nemas enter the grub by way of the mouth, develop two or three generations within the body, and destroy their host by feeding on the tissues. They continue to develop in the cadaver of the grub until most of the tissues have been consumed. The grub at death is flaccid, of a reddish-brown color, and swarming with nemas, most of them in the second stage ready to invade the soil and infect another host. As many as 2,400 infective-stage nemas

have been recovered from a single grub, but the usual number is about 1,500.

*N. glaseri* has been colonized in New Jersey and in Maryland. This is one of the few instances in which nematodes have been colonized for the control of an insect pest. It is spread slowly through the soil by its own movement and by nema-infected grubs. It may be carried considerable distances by infected adult beetles, by birds and small mammals, and in the movement of soil by wind, water, or man.

This nematode is not effective under so wide a range of conditions as the parasitic insects and the bacterial diseases, but in habitats suitable for its development it has parasitized more than 50 percent of the grubs.

*Neoaplectana chresima* Steiner also infects Japanese beetle grubs. The biology of this species is similar to that of *N. glaseri*. Other nemas infecting grubs of this beetle have been found occasionally in the field. The possibilities of *N. chresima* and the other nematodes for control of the beetle have not been investigated.

### **Rickettsias**

A fatal infection of Japanese beetle grubs caused by *Coxiella popilliae* Dutky, one of the rickettsias, was discovered at Nottingham, Pa., in 1940. It has since been encountered in grubs from several widely separated areas. At some localities large numbers of diseased grubs have been found repeatedly. The affected grubs have a greenish-blue discoloration of the fat bodies, which led to its designation as blue disease. Attempts to colonize this rickettsia in other areas have been only partially successful.

### **Bacteria**

In 1921 it was recognized that bacterial diseases existed among Japanese beetle grubs. In 1926 and 1927 several species of bacteria were isolated from affected grubs, some of which proved to be highly pathogenic. Only a few bacteria have been studied extensively, the most important being the organisms causing the milky disease of the grubs.

Milky disease was discovered in New Jersey in 1933, when a few abnormally white grubs were found in the field, and microscopic examination showed that the blood of these grubs was teeming with bacterial spores. By 1938 milky disease was prevalent in the older areas infested by the beetle, but it was not found in the more recently infested areas. In 1940 it was demonstrated that this disease was caused by two species of bacteria, *Bacillus popilliae* Dutky, and *B. lentimorbus* Dutky. *Bacillus popilliae* is the better known, and probably the more important.

The origin of the milky disease organisms is not known. It is probable that they are obligate parasites of the white grub family, the Scarabaeidae, with the Japanese beetle being their most common host. These bacteria do not infect other insects, earthworms, warmblooded animals, or plants.

The spore stage of *B. popilliae* normally occurs in the soil. As the grubs work their way through soil, feeding on roots and other vegetable matter, they ingest the spores along with the other material. The spores germinate, penetrate the wall of the gut, and enter the

blood as the vegetative stage. Infection does not begin until the vegetative forms of the bacterium appear in the blood. The bacteria multiply in the blood, giving it a cloudy appearance. Just what induces sporulation is not known, but it occurs when the vegetative forms become exceedingly numerous. Sporulation continues until all the bacteria have reached the definitive spore stage, completing the cycle. At that time the blood becomes milky white in appearance, and usually contains more than 2 billion spores.

A close relationship exists between the development of infection and the ability of a grub to metamorphose. It is possible for a grub to molt before the bacterium has completed its cycle. If, at the normal time of pupation, the bacterium is not in its final stage, metamorphosis proceeds in an apparently normal manner. In that case sporulation occurs in the blood of the adult beetle. After the spores appear in the blood of a grub, it does not usually develop further.

In contrast to many entomogenous, septicemic diseases, which kill the host within a few hours or days, *B. popilliae* passes through a slow, methodical course of development. Many grubs live for weeks, or even months, after the blood has become loaded with spores, particularly at low temperatures. It is not uncommon for grubs that become infected late in the fall to live until they resume activity in the spring. Not only do infected grubs remain alive, but they continue to feed. As death approaches, the grubs become less active and then moribund. At that time the circulation of the blood stops and the bacteria settle to the bottom of the body cavity.

The spores of *B. popilliae* are very resistant to adverse conditions and may remain in the soil for many years, ready to infect successive generations of grubs. The spores remain alive after having passed through the digestive tracts of birds and small mammals that have eaten infected grubs. The potency of the spores is reduced when the pH of the soil is less than 5.0, or they are exposed to ultraviolet light or sunlight. There is also some loss of potency when spores are heated above 194° F., or kept under refrigeration in a water suspension.

The temperature for the development of *B. popilliae* seems to be between 60.8° and 96.8° F. A temperature above 70° F. is required for the rapid buildup of the pathogen in an area. In Virginia, a definite buildup of the organism occurred in 1 year, but in Connecticut and New York, 3 to 4 years were required.

During the period from 1939 to 1953, an extensive program of colonization of *B. popilliae* was conducted in cooperation with various State and Federal agencies to accelerate the spread and buildup of the pathogen. When that program was discontinued, the bacterium had been colonized at 123 thousand sites in 14 eastern States and the District of Columbia. A dense population of grubs and a high inoculum potential favor the establishment and the rapid spread of the organism. The successful use of *B. popilliae* depends upon its transmission from grub to grub. Since the pathogen may be transmitted from the grubs to the adult beetles, the adult beetles with their migratory habits aid in the dispersion. The organism is also spread by other insects, birds, skunks, and moles, and in the movement of infected soil.

Although widespread distribution of the pathogen was not undertaken until 1939, and only a small portion of the land in a given area was inoculated, by 1945 there was a high incidence of the disease in

Connecticut, New York, New Jersey, Delaware, and Maryland, where treatments had been applied early in the program. A survey in the fall of 1960 showed that the organism was well established and functioning at many sites within the beetle-infested region.

*Bacillus lentimorbus*, the other bacterium causing milky disease, often occurs in close association with *B. popilliae*. The biology of this species is similar to that of *B. popilliae*, but it has a more limited range of temperature for its development. It also is an important factor in the biological control of the Japanese beetle.

*Serratia marcescens* Bizio, a red-pigmented bacterium discovered in 1951, is highly pathogenic to the grubs. This bacterium occurs commonly in nature, but it probably is not an important factor in the control of the grubs.

*Bacillus alvei* Ches. and Chey., the bacterium associated with European foulbrood of the honey bee, is also highly pathogenic to the grubs. This pathogen has not been investigated further for the control of the beetle.

## STATUS OF THE BEETLE IN 1962

Populations of beetles are increasing in those areas recently invaded by the insect, but in those areas invaded prior to 1945, the populations are generally small and of little economic importance, except in special situations. In the older infested areas, the biological balance between the pest and its natural enemies appears to be fairly well established, but it is unlikely that the beetle will ever be eliminated by natural control agents. Since the beetle has become a part of the permanent fauna of the region, the density of the annual broods can be expected to fluctuate to some extent from year to year, depending largely upon whether the rainfall in the early summer is adequate or inadequate for the hatching of the eggs and the development of the small grubs. When the soil is moist during that period, invariably there are more beetles in an area the following summer. However, it is not expected that beetle populations will ever again build up to epidemic proportions in the older infested areas.

Even in the older infested region sporadic upsurges of the beetle population can be expected in areas where parasites, diseases, and other biotic control agents are not well established, or have been eliminated inadvertently by man. In some areas where parasites and diseases have been colonized, beetle populations have remained too low for an adequate buildup of these biotic control agents, possibly because adverse conditions, such as dry summers, prevented the buildup of beetle populations. When conditions are suitable for development of the beetle, a few years may elapse before disease and parasites are sufficiently abundant to cope with it. The application of insecticides to turf practically eliminates grub populations for several years, thus preventing the establishment of parasites and disease in the treated area, but when these chemicals have dissipated in the soil, there is then no restraining factor to inhibit the buildup of a grub population. Extensive grading operations at large housing developments generally eliminate any enemies of the beetle that might be present originally in the surface layer of soil; a few years may elapse before these enemies become reestablished. Meanwhile, the large ex-

panse of unprotected turf at a housing development is conducive to a rapid buildup of a local beetle population.

Protecting plants from the ravages of the beetle is now much easier than in the early days of its invasion into the eastern States. The insecticides then available were only partially effective in protecting plants from attack by the adult beetle; little was known about the control of grubs in the soil. Now, with light populations of beetles in the older infested areas and potent insecticides available, it is relatively easy to prevent them from doing extensive damage. Foliage and fruit can be protected by timely applications of sprays containing DDT, methoxychlor, Sevin, malathion, or parathion. Lawns and golf courses can be protected for 5 or more years by a single application of aldrin, heptachlor, dieldrin, chlordane, toxaphene, or DDT.

The Japanese beetle is no longer a serious menace to American agriculture within the older infested area on the Atlantic Seaboard. It is largely a nuisance and an annoyance to the suburbanites. With its natural enemies preventing the buildup of enormous populations, the beetle these days is no more difficult to control than many other pests that attack plants.